Highway Construction Productivity

Carl Haas, Ph.D., PEng, FASCE, FCAE, FNAC
Professor and Canada Research Chair in Construction and Management of Sustainable Infrastructure
Interim Chair of Department of Civil and Environmental Engineering
University of Waterloo
Outline

• Dire news – historical productivity trends
• Points of light – known sources of improvement
• Hope for the Future – promising strategies
Historical Productivity Trends

• Productivity metrics and applications
  • Labor productivity
  • Multi-factor productivity
  • Productivity factor
  • Direct work rate
• Units of construction output definitions
• Cost deflators
• Geographic and sector variability

Index of US labour productivity

Non-farm business labour productivity
CAGR +1.9%

Relative improvement
+153%

CAGR -0.4%

Construction labour productivity

1 Peer set based on US companies with Engineering, Construction and Services-related Standard Industrial Classification codes. Financials are inflation-adjusted and indexed to 1964; output per working hours. CAGR = compound average growth rate.

Source: Global Vantage; Compustat; Bloomberg; www.aecbytes.com/viewpoint/2013/issue_67.html; www.nber.org/papers/w1555.pdf; S&P Capital IQ; BCG ValueScience Center; World Economic Forum

Based on The Boston Consulting Group, 2015a; The Boston Consulting Group, 2015b; and The Boston Consulting Group, 2015c

Multifactor Productivity (1987-2012)
(US Bureau of Labor Statistics Multifactor Productivity Databases)

Manufacturing Industry
Compound rate = 1.35%

Construction Industry
Compound rate = -0.47%

Prof Paul Goodrum, University of Colorado – Boulder
US Highway Construction Labor Productivity and Performance, 2002-2014

US Highway and Industrial Construction Productivity, 2002-2014

US Road Construction Productivity and Performance, 1920-1970

F. Moavenzadeh

Excavation/Hauling (100 BCM/HR)

Surfacing

Double Bituminous Surface Treatment Over Gravel (100 sm/hr)

Transportation Research Part A: General Volume 19, Issues 5–6, September–November 1985, Pages 497-509

Special Issue Transportation Research: The State of the Art and Research Opportunities, Research needs in transportation facilities: guideway technology and materials research, Fred Moavenzadeh
Why did it happen?
US Price Trends in General and Highway Construction, 1915-1975

Fig. 4. Price trends exhibited by industry, in general, and the construction and highway construction sectors over the past 60 years.


Mean Percent Change in Activity Partial Factor Productivity, 1976-1998

Fig. 2. Mean percent change for activity partial factor productivity by division, 1976–1998

Nations’ Construction Productivity vs Productivity Growth Rate

Sources of Improvement
Tools for Productivity Improvement

INSERT REFERENCE HERE

Fig. 3. Positive changes in equipment technology by technology factor, 1976–1998

Automation and Integration

• Automation
  • The use of an electronic or computerized tool by a human being to manipulate data or produce a product

• Integration
  • The sharing of information between project participants or melding of information sourced from separate systems
The Percentage Difference in Productivity due to Advanced Information Systems

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Practices for Productivity Improvement

Methodology and Procedure

Productivity Normalization

Divide the practices into low and high level practice use groups

• Low-level
  (Practice Use Index < (Median - 5%))

• High-level
  (Practice Use Index > (Median + 5%))
Preliminary Results for Infrastructure BPPII (Best Productivity Practices Implementation Index)

Promising Strategies
Interface Management (IM) + BIM
IM Level of Implementation vs Cost Growth

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<tr>
<th>Groups</th>
<th>Count</th>
<th>Sum</th>
<th>Average</th>
<th>Variance</th>
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Stakeless earth moving

- https://www.youtube.com/watch?v=3cWZCPJccvM
Complete Interoperability (e.g. Infrakit)

- https://www.youtube.com/watch?v=99bQxNpasu0
“Future of Construction” website

- A central platform to exchange best practices and ideas guiding the infrastructure and urban development industry in its transformation, and helping it to address its key challenges.
- https://futureofconstruction.org/blog/
- World Economic Forum
- The Boston Consulting Group
- The University of Waterloo
Summary

• Productivity growth is becoming harder
• Sources of improvement include:
  • **Interoperability** of information and control systems
  • Automated and more powerful equipment
  • Implementation of known best practices
  • Development of new materials (such as warm asphalt) that use less energy to work and set
  • Contracting strategies to incentivize collaboration, innovation and best practices
References


- Transportation Research Part A: General Volume 19, Issues 5–6, September–November 1985, Pages 497-509 Special Issue Transportation Research: The State of the Art and Research Opportunities Research needs in transportation facilities: guideway technology and materials research Fred Moavenzadeh


